

# X-ray Structure Determination

*A PRACTICAL GUIDE*

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EXHIBIT A

*In Memoriam*  
**A. L. PATTERSON**

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## 54 Symmetry Operations and Space Groups

[Ch. 3]

Table 3.2 Space Groups in Standard Orientations\*

| System       | Point groups | Space groups       |                                  |   | Fraction                         |
|--------------|--------------|--------------------|----------------------------------|---|----------------------------------|
| Triclinic    | 1            | P1                 |                                  |   | 1/2                              |
|              | 1            | P1                 |                                  |   |                                  |
|              | 2            | P2                 | P2 <sub>1</sub>                  | C2  | 1/4                              |
| Monoclinic   | m            | Pm                 | Pc                               | Cm  |                                  |
|              | 2/m          | P2/m               | P2 <sub>1</sub> /m               | C2/m  |                                  |
|              |              |                    |                                  | P2 <sub>1</sub> /c                            | C2/c                             |
| Orthorhombic | 222          | P222               | P22 <sub>1</sub>                 | P2 <sub>1</sub> 2 <sub>1</sub> 2 <sub>1</sub> | C222 <sub>1</sub>                |
|              |              | P222               | P222                             | P2 <sub>1</sub> 2 <sub>1</sub> 2 <sub>1</sub> | C222 <sub>1</sub>                |
|              | mm2          | Pmm2               | Pmc2 <sub>1</sub>                | Pma2  | Pmc2                             |
|              |              | Pmm2 <sub>1</sub>  | Pba2                             | Pma2  | Cmc2 <sub>1</sub>                |
|              |              | Ccc2               | Amn2                             | Amn2  | Fmm2                             |
|              |              | Fdd2               | Imn2                             | Ima2  |                                  |
|              | mmm          | Pmm                | Pmn                              | Pbn   | Pma                              |
|              |              | Pmm                | Pca                              | Pbn   | Pbm                              |
|              |              | Pmm                | Pba                              | Pbn   | Pbm                              |
|              |              | Cmm                | Pba                              | Pbn   | Pbm                              |
|              |              | Cmm                | Pba                              | Pbn   | Pbm                              |
|              |              | Imn                | Imn                              | Imn   | Fdd                              |
| Tetragonal   | 4            | P4                 | P4 <sub>1</sub>                  | P4 <sub>2</sub>                               | P4 <sub>1</sub>                  |
|              | 2            | P4                 | P4 <sub>1</sub>                  | P4 <sub>2</sub>                               | P4 <sub>1</sub>                  |
|              | 4/m          | P4/m               | P4 <sub>1</sub> /m               | P4 <sub>2</sub> /m                            | P4 <sub>1</sub> /m               |
|              |              |                    |                                  |   | P4 <sub>1</sub> /m               |
|              |              |                    |                                  |   | P4 <sub>1</sub> /m               |
|              |              |                    |                                  |   | P4 <sub>1</sub> /m               |
|              | 422          | P422               | P4 <sub>1</sub> 2 <sub>1</sub> 2 | P4 <sub>2</sub> 2 <sub>1</sub> 2              | P4 <sub>1</sub> 2 <sub>1</sub> 2 |
|              |              | P4 <sub>1</sub> 22 | P4 <sub>1</sub> 2 <sub>1</sub> 2 | P4 <sub>2</sub> 2 <sub>1</sub> 2              | P4 <sub>1</sub> 2 <sub>1</sub> 2 |
|              |              | P4 <sub>1</sub> 22 | P4 <sub>1</sub> 2 <sub>1</sub> 2 | P4 <sub>2</sub> 2 <sub>1</sub> 2              | P4 <sub>1</sub> 2 <sub>1</sub> 2 |
|              |              | P4 <sub>1</sub> 22 | P4 <sub>1</sub> 2 <sub>1</sub> 2 | P4 <sub>2</sub> 2 <sub>1</sub> 2              | P4 <sub>1</sub> 2 <sub>1</sub> 2 |
|              |              | P4 <sub>1</sub> 22 | P4 <sub>1</sub> 2 <sub>1</sub> 2 | P4 <sub>2</sub> 2 <sub>1</sub> 2              | P4 <sub>1</sub> 2 <sub>1</sub> 2 |
|              |              | P4 <sub>1</sub> 22 | P4 <sub>1</sub> 2 <sub>1</sub> 2 | P4 <sub>2</sub> 2 <sub>1</sub> 2              | P4 <sub>1</sub> 2 <sub>1</sub> 2 |

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